

HORIZON
2020

Most Easy, Efficient and Low Cost Geothermal Systems for Retrofitting Civil and Historical Buildings

Risultati

Informazioni relative al progetto

GEO4CIVHIC

ID dell'accordo di sovvenzione: 792355

[Sito web del progetto](#)

DOI

[10.3030/792355](https://doi.org/10.3030/792355)

Progetto chiuso

Data della firma CE

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Data di avvio

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**Data di
completamento**

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Coordinato da

CONSIGLIO NAZIONALE DELLE
RICERCHE

 Italy

Questo progetto è apparso in...



20 Settembre 2022



5 Settembre 2023



CORDIS fornisce collegamenti ai risultati finali pubblici e alle pubblicazioni dei progetti ORIZZONTE.

I link ai risultati e alle pubblicazioni dei progetti del 7° PQ, così come i link ad alcuni tipi di risultati specifici come dataset e software, sono recuperati dinamicamente da [.OpenAIRE](#)

Risultati finali

Documents, reports (30)

[First report on implementation of Training, Education and Dissemination activities](#) 

The first report on implementation of Training, Education and Dissemination activities will detail all the dissemination actions implemented during the reporting period (M1-M12) by each partner in the project. The report will present concrete information with regard to dissemination and communication activity: actions / events / documents planned / accomplished by the project partners. This document will be elaborated by the WP8 leading partner on the basis of each partner individual reports done according the project strategy and reporting format set up Month 6 and presented in D8.3. Special emphasis will be placed on estimating the effectiveness of dissemination and communication activities, and on quantifying their efficiency whenever possible. Related to Task 8.1

[Cost-effectiveness demonstration](#)

This deliverable compiles results of the cost studies that will be performed on the virtual and real demonstrations used for evaluating the GEO4CIVHIC technology in both the civil and historical building segments providing an analysis which includes the whole retrofit lifecycle with initial capital costs and discounted expected yearly savings and then consolidates this information with the replication potential of the technologies risks and possible deviations. This will truly reflect the cost effectiveness of the solution relative to other solutions in the market through the comparison of KPIs such as discounted payback periods. Related to Task 7.2

[Market and Business innovation 1st version](#)

The first iteration of this deliverable will provide insight on the external factors in the competitive landscape that are likely to steer the creation of innovative business, product and service strategies. This involves a continuous scanning of technological, political, economic, legal and social trends that are pertinent to the project so that appropriate contingency plans can be established in case of external competitive or market driven pressure. Moreover, market data such as market size, growth rates and regional dynamics should be established in order to efficiently position project results when formulating the innovative business model. Related to Task 7.3

[Report on outline Environmental Impact of GEO4CIVHIC technologies at case study sites](#)

The report will include the overview of the environmental impacts of the heat exchanger technologies, the drilling methodologies, the retrofit measures implemented and the heat pump and delivery systems installed at the real case study sites. The specific EIA sections to be considered will be outlined in communal chapters of the report with specific sub sections dedicated to each project. The various sections will make reference to key regulatory requirements that may be present in the case study site jurisdictions and demonstrate the reduced impact at both installation and operational stages of the project technologies. Related to Task 6.1

[Guide for the use of the Application for a friendly and easy management of the energy systems](#)

Guide for the enduser to explain him the potential of the application and the way to use it. The guide will contain a simple explanation of the algorithm for a nonexpert enduser. Some picture of the mockup of the application will be included. Related to Task 4.4

[Report on different kind of barriers for shallow geothermal in deep renovation](#)

This report will focus on the various barriers against installation of shallow geothermal systems in deep renovation. Such barriers include technical issues (constraints for drilling and installation, integration into given heating or HVAC systems), legal and administrative aspects, and economics. In cases of

renovation and refurbishment, the technical barriers are usually much higher than for green-field developments, as constraints in site availability and the need to adapt to given building equipment call for bespoke solutions in each case. The report will evaluate these specific issues and classify the different constraints, to allow the development within the project being focussed on the most widespread problems and the most promising solutions. Related to Task 1.1

[BEMS user manual](#)

This is the user manual that will explain how to use the developed BEMS system to integrate multiple renewable energy sources to an expert user. It will include how to deploy the system and the different setting options available. The document will be the base for the part of the training manual developed in Task 82 that corresponds to WP4. Related to Task 46

[Report on the planning of the national Training Courses and Workshops](#)

The document is a planner for all the courses and workshops developed by the partners in their countries: Spain, Germany, Romania, Greece, Belgium, Wallonia, Belgium, Flanders, Ireland, Switzerland, and Italy. In each country, the education activity will include two different target stakeholders: the training course for specialists and the workshop for nonspecialists. In every training course and workshop, a particular section will be devoted to the applications in Historical Buildings. This deliverable will also define the general approach regarding the training teams, the methodology, course structure, content, and the evaluation criteria both for the courses and for the workshops. The document will be realized by the WP8 leader using inputs from all the partners responsible for national courses and workshops. The draft of this deliverable will be debated and approved in the last management meeting before M36. Related to Task 82

[Production of Training Manual and Technical brochure \(in English & national languages\)](#)

The training manual will contain the conclusions and deliverables of the previous WPs, which will be adapted to the trainees' interests and level of understanding. The training manual will include information about the most innovative technologies available today: short movies, virtual reality, animations, and interactive learning methods, quizzes. The content of the advanced training material is the responsibility of the key partners and WP leaders WP1-WP7, and it shall be approved by the PSC Projects Specific Committee in order to respect the IPR issues stipulated in CA. The training manual will be created in the English language and translated in different national languages. A special Technical Brochure in English will be devoted to the application to Historical Building. CNRISAC UNESCO. Related to Task 82

[Report on Networking Activities with Architects / Engineers Associations and private stakeholders' involvement in the process of dissemination](#)

This report is a public document PU and it contains information about the networking activities performed in the frame of Task 84 at national and international level such as a Joint common demonstration issues b Sharing project resultsoutcome combinations c Shared exhibition presentations d Jointly organized workshops seminars for ex inside AICARR REWHA etc e Meetings including the standardization legislation issues f Educational materials g Marketing activities h Meetings with ArchitectEngineers associations i Workshop with ArchitectEngineers associations The target groups are European and international professional Networks Initiatives Architect and Engineering Associations Platforms etc in the field of ConstructionBuildingRelated to Task 84

[Second report on implementation of Training, Education and Dissemination activities](#)

The second report on implementation of Training, Education and Dissemination activities will detail all the dissemination actions implemented during the reporting period (M13-M24) by each partner in the project. The report will present concrete information with regard to dissemination and communication activity: actions / events / documents planned / accomplished by the project partners. This document will be elaborated by the WP8 leading partner on the basis of each partner individual reports done according the project strategy and reporting format set up Month 6 and presented in D8.3. Special emphasis will be placed on estimating the effectiveness of dissemination and communication activities, and on quantifying their efficiency whenever possible. Related to Task 8.1

[Preliminary analysis and generation of possible different modular solutions description for civil and historical buildings](#)

This deliverable will collect the analysis of a modular set of possible solutions adapted to different scenarios developed in a matrix. Such scenarios will combine different climates building load profiles, drillability/access conditions to the site, basic constrains based on the characteristics of the H&C distribution in the building (civil/historical) and, finally, the possible local availability of other types of RES. The most appropriate GSHP solutions (blocks) will be identified depending on site conditions, identification and qualitative assessment of H&C sources to integrate geothermal energy in different scenarios and creating a portfolio of easily quantifiable indicators for a first feasibility analysis of the identified solutions. From the analysis developed in the deliverable, a catalogue of most common blocks of solutions aimed at specific building renovation scenarios will be developed to serve as input for the further GEO4CIVHIC DSS tools development. Related to Task 4.1

[Identification of historical buildings as real and virtual demonstration in UNESCO sites](#)

The deliverable will report on the processes and actions undertaken to identify the historical buildings performing as demonstrators for GEO4CIVHIC solutions localised in UNESCO designated sites. The deliverable will also describe the main technical characteristics of the identified buildings and related rooms to be

supplied by the innovative geothermal power facilities, both in terms of applied solutions (real cases) and assessment studies (virtual cases). The deliverable will also rely on the contribution of different project partners since it will collect in a standardised fashion, all historical buildings located in UNESCO designated sites and not only those referred to the tasks under the direct responsibility of UNESCO (Ferrara and Split). Related to Task 5.1

[Transferrable guideline for the integration of GSHP systems to historical buildings](#)

A report will be compiled to include specific guidelines for the integration of GHSP systems in historical buildings based on the review of applicable international best practice guidelines as well as local ones on retrofitting of historical buildings. The guidelines document will include principal sections that will consider the legislative conditions the permitting requirements relevant to GHSP and their integrations in historical buildings the design considerations for older buildings based on the identified project solutions integration of existing building services infrastructure and upgrade for operations with GSHPs as well as drilling and installation of heat exchangers. The document shall draw from the feedback obtained throughout the project to ensure that transferrable concepts relating to the above topics can be used in any jurisdiction. Related to Task 6.6

[GEO4CIVHIC DSS for geothermal retrofit user manual](#)

This deliverable is the user manual that will explain the use of the DSS tools developed to a non-expert user. It will include the functionalities of the DSS and the different options available through the web platform. The document will be the base for the part of the training manual developed in Task 8.2 that corresponds to WP4. Related to Task 4.3

[Recommendations for the planning and implementation of new GSHP systems in dense urban environments and related tool](#)

The deliverable will include a set of adaptable recommendations based on key regulatory and technical aspects of implementation with regard to integration of new GSHP systems in dense urban environments. The aim is to reduce management problems and thermal interference in areas where a high density of perforations are present and where ground heat exchanger systems are in close proximity to each other. The recommendations will facilitate improved management and sustainability of underground resources and the development of regulations that should nowadays include this theme and give indications and limits to allow for the correct planning and placement of boreholes. Differences existing among places (position, length and age of boreholes, type of ground...), thermal and technical aspects and best practices concerning the problem of thermal interference between near installations will be taken into account and evaluated in developing the set of recommendations. These recommendations will be also useful for the correct use of dedicated decision support tool developed in the project. Related to Task 6.2

[Production of brochure and leaflet](#)

The leaflet presents – in a concentrated form – the main information on the project, namely: title, acronym, addressed call and topic, general information, composition of the Consortium partners, general and specific objectives. The leaflet contains also information on the field test sites, pilot facilities and demo facilities (both real and virtual) which will serve to prove the viability of the technical solutions to be developed during the project's evolution. The brochure presents the same information as above, but in a more detailed form. The purpose of the leaflet and of the brochure is to disseminate the basic information with regard to the project, at its initial phase, throughout the target groups of the project. Related to Task 8.3

[Report on Training, Education and Dissemination Plan](#)

"The "Report on Training, Education and Dissemination Plan" ("TED Plan") is a public document delivered in the context of WP8, Task 8.1- Development of the Training, Education and Dissemination Plan with regard to the actions / events / documents for each target group and for each partner country in the project. The document will present the project own training, education and dissemination Strategy drawn up according to the EC recommendation and to the specific project objectives. It will present in detail each type of planned dissemination actions in order to allow the information to reach the target groups (architects, engineers, energy consultants, constructors, technicians, SMEs in the construction sector, building owners, local authorities etc.). The plan will increase the dissemination intensity during the project period from the initial presentation of project objectives in the early stages to the extensive presentation of the final research results in the late ones. The TED plan will be part of the first progress report and will be updated and completed for each reporting period. The TED plan will be implemented and continuously monitored by the WP leader and will be subject to annual report (deliverables in months 12, 24, 36 and 48). Related to Task 8.1"

[Recommendations to CEN Technical working groups for the technologies developed](#)

In the building sector the setting of appropriate and widely accepted standards is key for reliable quality. The widest coverage for standards in Europe is guaranteed under the CEN label with EN standards adopted in all CEN member countries. CEN has launched recently early 2017 a new committee CENTC451 on geothermal and water boreholes, the working group 2 of which is currently drafting standards for shallow geothermal wells. The report D66 will summarise the findings from the project concerning existing and newly developed BHE technology as proposed input for CENTC451WG2. Through the existing contacts via national standards organisations and involvement of project partners in standardisation, these recommendations will be brought to the attention of both CENTC451WG2 and other national standard committees like the one for VDI 4640 in Germany or for UNE 1007151 in Spain. In case of other items for

standardisation might pop up during the project building integration drilling technology HVAC control etc recommendations in these fields will be added and contact to the relevant committees will be sought Related to Task 65

[Market and Business innovation 2nd version](#)

According to market insights obtained in the first iteration of this deliverable as well as the established cost effectiveness of the solutions this version will optimally position the developed technologies within the market and detail the associated business model and value proposition along with the resulting operational requirements Relevant financial projections will be provided according to the established business model and plan Related to Task 73

[Common MCDA Methodology & Risk Assessment of individual case study sites](#)

The deliverable will comprise to key parts. Part A (M26) will include a risk assessment matrix that will describe technical and environmental aspects of implementation of the project technologies (drilling, heat exchangers and heat pumps) based on the regulatory and permitting requirements as well as the socio-economic aspects at the real and virtual case study locations. The matrix will allow the identification of the most adequate solutions and technology implementation strategies for each site. Part B (M36) will comprise a report that will outline the experiences of both the installation phase and operational phase of the technologies at the case study sites highlighting expected contingencies and deviations expected from the original strategies and demonstrating the mitigation measures implemented to overcome the challenges at each real case study site and by providing recommendations for the virtual sites. Related to Task 6.3

[Mapping of GSHP for cooling and for low and high temperature terminals for heating](#)

D3.1 will present an overview of market available Heat Pump configurations most suitable for retrofitting of buildings. Common applications (heating, cooling, hot water, etc.) will be considered with their corresponding refrigerant cycles and operating conditions. Possible control strategies will be defined. Selection rules to facilitate technology recommendation will be drafted, based on available typologies of terminals (high, medium or low temperature), used for building retrofit applications. Cost of the different Heat Pump configurations will be also estimated. Related to Task 3.1

[Application for support on field for workers on Geothermal field user manual](#)

This deliverable is the user Manual that will help to explain to the end user the use of the Application and its potential The deliverable will include some pictures of the mockup of the application This will be used for the dissemination and to easily explain to the end user how to use the Application Related to Task 44

[Report on activities of clustering and collaboration with other EU H2020 projects on shallow geothermal](#)

The report presents the results of the clustering activities based on the agreements of involved POs with the other running and new EU projects on the geothermal subject. The clustering activities are decided based on the annual meetings with the representatives of the other running and new EU projects which are meant to build up a plan of future common activities and to set synergies with respect to research dissemination and implementation on the European and the international market. The report also covers synergy activities performed by means of different associations and platforms RHC EGEC ECTP HR EeBA etc where a many of the partners of GEO4CIVHIC project are very active since a lot of years. Related to Task 85

[Regulatory analysis overview guide on the implementation of renewables and GSHP in retrofit scenarios and historical buildings](#) 

A report summarising the regulatory conditions of implementation of the EPDB in the context of the potential for deployment of GSHP systems to both retrofit and historical buildings will be completed. The deliverable will summarise those regulations or best practice guidelines that are in place at the case study sites that are specific to the refurbishment of historical buildings in the context of the integration of renewables and energy efficiency measures. Where these specific measures are not available, the deliverable will summarise adopted guidelines and best practices used in the context of the virtual and real case study sites considered in the project, identifying these as potential pillars for consideration in other jurisdictions with specific focus given to those most relevant to GSHP technologies (drilling, heat exchanger and heat pumps) developed in the project. The deliverable will facilitate the completions of guidelines for the integration of GSHP systems in historical buildings to be presented in D6.7 and in the development of the Business Innovations Models in WP7. Related to Task 6.1

[Overview of vertical geothermal heat exchangers and corresponding drilling machine techniques](#) 

There are three basic patterns of vertical geothermal heat exchangers (Borehole Heat Exchangers, BHE) possible: the coaxial type (concentric, tube-in-tube), the U-tube type (made from single tubes, differing in the type of bends and the number of pipes in one borehole), and complex designs based on a concentric concept (helicoidal, multi-tube-concentric, etc.). The report D2.1 will investigate what types are used in the partner countries and for which applications, and will elaborate on the merits and drawbacks of the different approaches, both in energetic and economic terms. Conclusions will be drawn on what concept is deemed to be best suited for applications in deep renovation. The report will also cover the respective drilling and installation equipment, with a specific emphasis on use in already built areas or even indoor space, as might be required for deep renovation. Related to Task 2.1

[Last report on Training, Education and Dissemination activities](#) 

The last (fourth) report on implementation of Training, Education and Dissemination activities will detail all the dissemination actions implemented during the reporting period (M37-M48) by each partner in the project. The report will present concrete information with regard to dissemination and communication activity: actions / events / documents planned / accomplished by the project partners. This document will be elaborated by the WP8 leading partner on the basis of each partner individual reports done according the project strategy and reporting format set up Month 6 and presented in D8.3. Special emphasis will be placed on estimating the effectiveness of training, education and dissemination activities, and on quantifying their efficiency whenever possible. Related to Task 8.1

[Preliminary cost and business analysis for different levels of renovation in different types of building, climates and underground conditions](#) 

This deliverable will provide the results of the preliminary cost study which is performed according to the buildings, climates and underground conditions that are modelled in task 1.3. The study will provide cost levels for different insulation and HVAC configurations as well as national costs of materials, insulations, operations and installation. These will be compared to the modelled energy results of the previous tasks in order to obtain economic KPIs that can highlight the potential of the solutions being developed. A database of economic KPIs related to the project comprising investment gaps between conventional and geothermal solutions, ROI and simple payback periods and cost benefit analyses for different renovation, building, climate and underground typologies and conditions at the European level will be provided as a result of these actions. Related to Task 1.4

[Third report on Training, Education and Dissemination](#) 

The third report on implementation of Training, Education and Dissemination activities will detail all the dissemination actions implemented during the reporting period (M25-M36) by each partner in the project. The report will present concrete information with regard to dissemination and communication activity: actions / events / documents planned / accomplished by the project partners. This document will be elaborated by the WP8 leading partner on the basis of each partner individual reports done according the project strategy and reporting format set up Month 6 and presented in D8.3. Special emphasis will be placed on estimating the effectiveness of dissemination and communication activities, and on quantifying their efficiency whenever possible. Related to Task 8.1

[Exploitation plan to increase the commercial attractiveness and the penetration of geothermal energy systems](#) 

The exploitation plan will have the role to increase the commercial attractiveness and the penetration of GSHPs and in particular in the retrofit market and will be based on a business model creation that will include data like 1 commercially

exploitable main project results 2 potential market 3 analysis of barriers for exploitation 4 exploitation scenarios and clientbased commercialization strategies to bench market launch steps 5 methodology and strategy for management of knowledge generated 6 the innovations and marketing interests in order to develop a mature project commercialization plan The exploitation plan will include also the exploitation potential and strategy of the project results routes for exploitation the target users and markets competitor analysis potential for investors internal or external and marketing strategies The partners will customize the exploitation plan according to their specific business model and the market demand specific in their country Related to Task 74

Websites, patent fillings, videos etc. (1)

[Production of website](#)

The “Production of website” is a public document delivered in the context of “WP8, Task 8.3: Communication of project’s results”. This document presents both the preparatory activities achieved prior to actual construction of the project’s website – such as: registration of a domain name and its purchase, elaboration of the offer request, launch of the offer requests, selection of the most qualified bidder and contract signing – and the construction of the first version of the project’s website by the selected webmaster, according to the technical specifications agreed upon with the partners of the consortium, as well. Related to Task 8.3

Demonstrators, pilots, prototypes (1)

[Modelling energy demand and plant typology study for different levels of renovation in different types of buildings, climates and grounds](#)

The first goal of the deliverable is to choose a single-user residential and a multi-user residential and non-residential buildings as representative of the building stock. The same selection will be carried out for a multi-user historical building. The energy demand profiles will be determined by modelling two different levels of insulation (medium, deep) in 3 climatic zones (North, Centre, South Europe). Different shallow geothermal plant typologies for heating and cooling will be simulated with 3 different underground characteristics (defined in Task 1.2) for each of the study cases where the energy demand profile has been modelled. A database of 170 building energy profiles will be developed and will integrate the existing Cheap-GSHPs database of energy demand with other 340 yearly energy profiles. A comparison using conventional H&C plants versus geothermal plant

typologies will provide data on the energy savings and the difference in primary energy use between the different plant typologies. Related to Task 1.3

Pubblicazioni

Other (3)



[Application of a method for the sustainable planning and management of ground source heat pump systems in an urban environment, considering the effects of reciprocal thermal interference](#)

Autori: Marco Belliardi; Linda Soma; Rodolfo Perego; Sebastian Pera; Eloisa Di Sipio; Angelo Zarrella; Laura Carnieletto; Antonio Galgaro; Borja Badenes; Riccardo Pasquali; David Bertermann; Burkhard Sanner

Pubblicato in: Open Research Europe, Numero 1, 2022

Editore: European Commission

DOI: 10.12688/openreseurope.14665.2

European Project GEO4CIVIC most easy, efficient and low-cost geothermal systems for retrofitting civil and historic buildings

Autori: Arch.Leonardo Rossi and Loredana Fodor

Pubblicato in: Construction Magazine, Numero no.202/may2023 / monthly, 2023

Editore: Construction Magazine

Preliminary findings in the Assessment of the Critical radius of Ground heat Exchangers: a Factorial design Approach

Autori: Gianluca Cadelano, Giorgia Dalla Santa, Eloisa Di Sipio, Adriana Bernardi, Giovanni Ferrarini, Paolo Bison, Alessandro Bortolin, Antonio Galgaro

Pubblicato in: 12th European Geothermal PhD Days 15-16 February 2021 France, 2021

Editore: Cergy Paris Université

Conference proceedings (15)



A Comparison Between Traditional and Hybrid Optic Fibre Based Ground Thermal Response Tests

Autori: Galgaro A, Schenato L, Pasquier P, Dalla Santa G,

Pubblicato in: Proceedings World Geothermal Congress 2020, 2022

Editore: International Geothermal Association

A First European Collection of Thermal Response Tests

Autori: Galgaro A; Dalla Santa G, Vercruysse J, Mendrinis D, Zarrella A, Moia F

Pubblicato in: Proceedings World Geothermal Congress 2020, 2022

Editore: International Geothermal Association

Long-term Monitoring of a Very Shallow Horizontal Collector System

Autori: Suft O., Bertermann D.

Pubblicato in: Proceedings of the European Geothermal Congress 2022, 2022, ISBN 978-2-9601946-2-3

Editore: EGEC

Assessing grouting mix thermo-physical properties for shallow geothermal systems

Autori: Garbin E, Mascarin L, Di Sipio E, Artioli G, Urchueguía J, Mendrinis D, Bertermann D, Vercruysse J, Pasquali R, Bernardi A, Galgaro A

Pubblicato in: Proceedings of the European Geosciences Union 2020, Sharing Geosciences Online, 2020

Editore: EGUsphere

Shallow Geothermal Energy for existing buildings – overview and status of project GEO4CIVHIC

Autori: Adriana Bernardi, Michele de Carli, Luc Pockelé, Fabio Poletto, Antonio Galgaro, Eloisa Di Sipio, Amaia Castelruiz, Javier Urchueguía, Borja Badenes, Riccardo Pasquali, David Bertermann, Luciano Mule'Stagno, Dimitrios Mendrinis, Jacques Vercruysse, Laura Fedele, Davide Menegazzo, Laura Carnieletto, Silvia Contini, Giulia Mezzasalma, Gianluca Cadelano, Alessandro Bortolin, Burkhard Sanner

Pubblicato in: 2022

Editore: EGEC

[The Impact of Conservation Conditions Versus Thermal Comfort of Visitors on the Energy Demand of a Museum Refurbished with Geothermal Systems: A Virtual Case Study](#)

Autori: Cadelano, G., Javanshir, S., Carnieletto, L., Bampa, F., Bortolin, A., De Carli, M., Di Sipio, E., Bernardi, A.

Pubblicato in: Lecture Notes in Mechanical Engineering, pp. 205 - 218, 2023, 3rd International Conference on The Future of Heritage Science and Technologies, Florence Heri-Tech 2022, 2022, ISBN 978-3-031-17594-7

Editore: Springer

DOI: 10.1007/978-3-031-17594-7_16

[Innovative drilling methods, heat pumps and tools to address shallow geothermal in the built environment: H2020 project - GEO4CIVHIC](#)

Autori: Adriana Bernardi, Luc Pockelé, Burkhard Sanner, Francesco Cicolin, Sergio Bobbo, Michele De Carli, Antonio Galgaro, Javier Urchueguía, Giulia Mezzasalma, Riccardo Pasquali, Fabio Poletto, Amaia Castelruiz Aguirre, Dirk Ulrich, Davide Poletto, Robert Gavriluc, Dimitrios Mendrinis, Davide Righini,

Jacques Vercruysse, Leonardo Rossi, Michele Vavallo, Luciano Mule'Stagno, Marco Belliardi

Pubblicato in: EGEC geothermal, 2019, Pagina/e Paper 233, 8 pages, ISBN 978-2-9601946-1-6

Editore: EGEC aisbl

DOI: 10.5281/zenodo.3557745

[A new effort to address shallow geothermal energy supply in the built environment : H2020-Projet GEO4CIVHIC](#)

Autori: Luc Pockelé, Burkhard Sanner, Adriana Bernardi

Pubblicato in: International Sustainable Energy Conference – ISEC 2018, 2018, Pagina/e 9 pages

Editore: AEE INTEC

DOI: 10.5281/zenodo.3557769

[Optimization methodology of borehole heat exchangers \(BHE\) according geometric characteristics, material properties and installation and operating cost](#)

Autori: Borja Badenes, Miguel A. Mateo, José M. Cuevas, Lenin G. Lemus, Jose V. Oliver and Javier F. Urchueguía

Pubblicato in: Alternative Energy Sources, Materials & Technologies (AESMT'19), Volume I 2019, Numero annual, 2019, Pagina/e pp. 37 - 38, ISSN 2603-364X

Editore: House Imeon Sole-owner

DOI: 10.5281/zenodo.3558273

[Impact of Climate Conditions and Energy Prices on Museums Refurbishments in Different European Countries Based on Geothermal Energy, Electrical Power or Natural Gas Systems](#)

Autori: Gianluca Cadelano, Francesco Cicolin, Giuseppe Emmi, Michele De Carli, Giulia Mezzasalma, Giorgia Dalla Santa, Adriana Bernardi

Pubblicato in: 14th SDEWES, 2019

Editore: SDEWES proceedings

DOI: 10.5281/zenodo.3557899

[Innovative Geothermal Application Development to support in situ workers](#)

Autori: Di Sipio E, Contini S, Mezzasalma G, Dalla Santa G, Galgaro A, De Carli M, Carnieletto L, Zarrella A, Castelruiz A, Pockelè L, Bernardi A

Pubblicato in: EGU General Assembly 2022, 2022

Editore: EGU sphere

DOI: 10.5194/egusphere-egu22-7806

[New borehole heat exchanger thermal enhanced grout formulations](#)

Autori: Di Sipio E, Garbin E, Fedele L, Menegazzo D, Mascarin L, Dalla Santa G, Bobbo S, Artioli G, Bernardi A, Galgaro A

Pubblicato in: EGU General Assembly 2021, 2021

Editore: EGUsphere

DOI: 10.5194/egusphere-egu21-8234

Trends in the European research in the domain of heating and cooling systems with geothermal heat pumps - Research projects financed by the European Commission (Cheap-GSHPs and GEO4CIVHIC)

Autori: Robert Gavriluc, Doinita Cucueteanu, Tiberiu Catalina

Pubblicato in: WEC CENTRAL & EASTERN EUROPE ENERGY FORUM – FOREN 2020, 2020

Editore: Romanian National Committee of the World Energy Council

Feasibility considerations regarding the implementation of a GSHP system for an industrial facility

Autori: R. Gavriluc

Pubblicato in: 50th Congress for Heating, Ventilation and Air Conditioning of the Serbian HVAC Association - December 4th - 6th, 2019 – Belgrade (Serbia), 2019

Editore: Scientific committee of the Conference

[European drillability mapping for shallow geothermal applications](#) 

Autori: Galgaro A, Di Sipio E, Dalla Santa G, Ramos Escudero A, Cuevas Jm, Sanner B, Righini D, Pasquali R, Vercruysse J, Bertermann D, Pockele L, Bernardi A

Pubblicato in: Proceedings of the European Geosciences Union 2020, Sharing Geosciences Online, 2020

Editore: EGUsphere

DOI: 10.5194/egusphere-egu2020-8584

Peer reviewed articles (18)


[Adapted composite two-region line source methods for evaluation of borehole heat exchangers with advanced materials](#) 

Autori: Javier F. Urchueguía; Borja Badenes; Hossein Javadi; Miguel Ángel Mateo; Bruno Armengot

Pubblicato in: Applied Thermal Engineering, 2023, ISSN 1359-4311

Editore: Pergamon Press Ltd.

DOI: 10.1016/j.applthermaleng.2023.120910

[Selection of backfill grout for shallow geothermal systems: Materials investigation and thermo-physical analysis](#) 

Autori: Ludovico Mascarin; Enrico Garbin; Eloisa Di Sipio; Giorgia Dalla Santa; David Bertermann; Gilberto Artioli; Adriana Bernardi; Antonio Galgaro

Pubblicato in: Construction and Building Materials, Numero 318, 2022, ISSN 0950-0618

Editore: Elsevier BV

DOI: 10.1016/j.conbuildmat.2021.125832

[Potential of GSHP coupled with PV systems for retrofitting urban areas in different European climates based on archetypes definition](#)

Autori: Laura Carnieletto; Antonino Di Bella; Davide Quaggiotto; Giuseppe Emmi; Adriana Bernardi; Michele De Carli

Pubblicato in: Energy and Built Environment, Numero 5(3), 2023, Pagina/e 374-392, ISSN 2666-1233

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Autori: Gianluca Cadelano; A. Bortolin; G. Ferrarini; Paolo Bison; Giorgia Dalla Santa; Eloisa Di Sipio; Adriana Bernardi; Antonio Galgaro

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Autori: Sergio Bobbo, Laura Fedele, Marco Curcio, Anna Bet, Michele De Carli, Giuseppe Emmi, Fabio Poletto, Andrea Tarabotti, Dimitris Mendrinou, Giulia Mezzasalma, Adriana Bernardi

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Autori: Hossein Javadi; Javier F. Urchueguía; Seyed Soheil Mousavi Ajarostaghi; Borja Badenes

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